Claims

What is claimed is:

1 A method of allocating resources within an optical network comprising the steps of:

providing a request for an optical path from a first node for transmission to a second other node;

providing a first query signal proposing at least a timeslot/wavelength channel pairing for an optical path corresponding to the request for an optical path;

receiving the query signal and data relating to availability of switching elements disposed within the optical path between the first node and the second other node;

selecting one of the proposed timeslot/wavelength channel pairings for the data transmission; and,

providing a command signal to each switching element requiring configuration to allow said elements to be configured for the selected timeslot/wavelength channel pairing to support communication from the first node to the second node of the provided data.

2. A method of allocating resources according to claim 1 wherein the command signal is provided to nodes and elements other than the element performing the step of selecting.

3. A method of allocating resources according to claim 1 wherein the included data includes data relating to switching element setup times to ensure that switching elements are available within a selected timeslot.

4. A method of allocating resources according to claim 1 wherein the timeslot is larger than the timeslot necessary to transmit the data in order to accommodate timing synchronization errors within the network.

5. A method of allocating resources according to claim 1 wherein the first query signal is transmitted from the first node.

6. A method of allocating resources according to claim 1 wherein the step of selecting is performed by the second other node.

7. A method of allocating resources according to claim 6 wherein the first query signal is transmitted from the first node.

8. A method of allocating resources according to claim 1 wherein the step of selecting is performed by the first node.

9. A method of allocating resources according to claim 7 wherein the command signal is provided via a return path from the second other node to the first node.

10. A method of allocating resources according to claim 1 wherein some of the switching elements are absent wavelength conversion capabilities.

11. A method of allocating resources according to claim 10 wherein the switching elements are absent buffering capabilities for buffering optical data.

12. A method of allocating resources according to claim 10 wherein the timeslot/wavelength channel pairing comprises a same wavelength channel for supporting the communication along an entire optical communication path from the first node to the second other node.

13. A method of allocating resources according to claim 12 wherein the second node receives a plurality of signals each including data relating to timeslot/wavelength channel pairing availability for a same optical path.

14. A method of allocating resources according to claim 13 wherein the included data includes data relating to switching element setup times to ensure that switching elements are available within a selected timeslot.

15. A method of allocating resources according to claim 12 wherein the timeslots are each shifted one relative to the other in dependence upon a known latency between switching elements.

16. A method of allocating resources according to claim 15 wherein the timeslot is larger than the timeslot necessary to transmit the data in order to accommodate timing synchronization errors within the network.

17. A method of allocating resources according to claim 16 wherein the timeslot is a non-contiguous timeslot.

18. A method of allocating resources according to claim 16 wherein the switching elements provide additional statistical data relating to timeslot availability.

19. A method of allocating resources according to claim 18 wherein the step of selecting is performed absent a guarantee of timeslot/wavelength channel availability.

20. A method of allocating resources according to claim 1 wherein the step of selecting is performed absent a guarantee of timeslot/wavelength channel availability.

21. A method of allocating resources according to claim 1 wherein a switching element comprises a wavelength conversion component and wherein said switching element provides proposed timeslot/wavelength channel pairings for optical data communication downstream of said switching element.

22. A method of allocating resources according to claim 21 wherein the timeslot/wavelength channel pairing comprises two different wavelength channels one

before a wavelength converter and another after the wavelength converter along the optical communication path.

23. A method of allocating resources according to claim 1 wherein a proposed timeslot/wavelength channel pairing extends sufficiently far into the future to approximately guarantee timeslot availability.

24. A method of allocating resources according to claim 1 wherein two timeslot wavelength channel pairings are selected for transmission of same data within each thereof.

25. A method of allocating resources according to claim 1 wherein two timeslot wavelength channel pairings are selected for transmission of a portion of the data within each thereof.

26. A method of allocating resources according to claim 1 wherein the timeslots are each shifted one relative to the other in dependence upon a known latency between switching elements.

27. A method of allocating resources according to claim 26 wherein the timeslot is larger than the timeslot necessary to transmit the data in order to accommodate timing synchronization errors within the network.

28. A method of allocating resources according to claim 26 wherein the timeslot/wavelength channel pairing comprises two different wavelength channels one before a wavelength converter and another after the wavelength converter along the optical path.

29. A method of allocating resources according to claim 28 wherein a timeslot is larger than the timeslot necessary to transmit the data in order to accommodate timing synchronization errors within the network.

30. A method of allocating resources according to claim 1 wherein the selection is performed absent a guarantee of timeslot/wavelength channel availability.

31. A method of allocating resources according to claim 1 wherein the timeslot/wavelength channel pairing comprises a same wavelength channel for supporting the communication along an entire optical communication path from the first node to the second other node.

32. A method of allocating resources according to claim 31 wherein selected timeslot/wavelength channel pairing includes path information for establishing a communication path within the timeslot/wavelength channel pairing along an optical path relating to the path information.

33. A method of allocating resources according to claim 1 comprising the steps of:

at each switching element receiving the query signal and determining data relating to the proposed timeslot/wavelength channel pairing;

including within the query signal the determined data; and,

transmitting the query signal including the determined data.

34. A method of allocating resources according to claim 1 comprising the steps of:

at each switching element receiving the signal and determining data relating to the selected timeslot/wavelength channel pairing; and,

transmitting a counter propagating signal along a path in a direction counter propagating to the signal and indicative of the determined data.

35. A method of allocating resources according to claim 1 wherein the query signal is provided along a plurality of optical data paths between the first node and the second node, and wherein the step of selection includes selecting a path of the plurality of paths.

36. A method of allocating resources according to claim 1 wherein the data for performing the step of selection is weighted based on a general availability of each switching element within the optical path.

37. A method of allocating resources according to claim 36 wherein the busiest element within the optical path is the element that performs the step of selecting.

38. A method of allocating resources according to claim 1 wherein data for performing the step of selection is provided from only a subset of the switching elements between the first node and the second node along the optical path.

39. A method of allocating resources within an optical network comprising the steps of:

providing a request for an optical path from a first node for transmission to a second other node;

providing a first query signal to the second other node;

at the second other node, selecting a timeslot/wavelength channel pairing for an optical path according to the request for an optical path absent predetermined knowledge that the timeslot/wavelength channel pairings is available for the transmission; and,

providing a command signal to each element requiring configuration to allow said elements to be configured for the selected timeslot/wavelength channel pairingalong an optical path according to the request for an optical path.

40. A method of allocating resources according to claim 39 wherein the command signal is provided to nodes and elements other than the element performing the step of selecting.

41. A method of allocating resources according to claim 39 wherein the first query signal is transmitted from the first node.

42. A method of allocating resources according to claim 41 wherein the command signal to each element is provided via a return path from the second other node to the first node.

43. A method of allocating resources according to claim 39 wherein some of the switching elements are absent wavelength conversion capabilities.

44. A method of allocating resources according to claim 43 wherein the switching elements are absent buffering capabilities for buffering optical data.

45. A method of allocating resources according to claim 43 wherein the timeslot/wavelength channel pairing comprises a same wavelength channel for supporting the communication along the entire length of the optical path from the first node to the second other node.

46. A method of allocating resources according to claim 45 wherein the second node receives a plurality of signals each including data relating to timeslot/wavelength channel pairing availability for an at least an optical path.

47. A method of allocating resources according to claim 45 wherein the timeslots are each shifted one relative to the other in dependence upon a known latency between switching elements.

48. A method of allocating resources within an optical network comprising the steps of:

absent a priori knowledge of a fixed communication timeslot/wavelength channel pairing between nodes or of a known available optical path between nodes, generating a first optical signal within a known timeslot/wavelength channel pairing at a first node and destined for a second other node;

providing the first optical signal to a switching fabric;

propagating the first optical signal within the switching fabric to the second other node; and,

receiving the first optical signal at the second other node.

49. A method of allocating resources within an optical network according to claim 48 wherein the step of propagating is performed absent a step of opto-electronic conversion.

50. A method according to claim 48 wherein the step of propagating the first optical signal comprises the step of:

providing the first optical signal along each of several optical communication paths within at least a timeslot/wavelength channel pairing.

51. A method according to claim 50 wherein the step of propagating the first optical signal comprises the step of:

performing within each path independently one of blocking the first optical signal and other than blocking the optical signal.

52. A method according to claim 48 including the steps of:

generating a second optical signal within a known timeslot/wavelength channel pairing at the first node and destined for the second other node;

providing the second optical signal to the switching fabric

wherein the steps of providing the first optical signal and providing the second optical signal are performed in sequence, such that the first and second signals are provided to the switching fabric within different timeslots.

53. A method according to claim 52 wherein the first and second optical signals are each within a same wavelength channel.

54. A method according to claim 52 wherein the first and second optical signals are each within a different wavelength channel.

55. A method according to claim 48 wherein the light source is one of a plurality of light sources each dedicated to generating light within a different known optical wavelength channel.

56. A method according to claim 55 wherein the first optical signal is blocked within the switching fabric when an optical path to the second other node within the known timeslot/wavelength channel pairing is unavailable.

57. A method according to claim 56 comprising the step of:

upon blocking of the first signal within the switching fabric, transmitting a message to the first node indicative of the first signal being blocked.

58. A method according to claim 57 comprising the steps of:

generating a second optical signal within a different timeslot/wavelength channel pairing at the first node and destined for the second other node and having the same data modulated therein in response to the message; and,

providing the second optical signal to a switching fabric in response to the message.

59. A method according to claim 48 comprising the steps of:

generating a second optical signal within a second other timeslot/wavelength channel pairing and including same data as the first optical signal; and,

providing the second optical signal to the switching fabric.

60. A method according to claim 59 wherein the first and second optical signals are provided to the switching fabric approximately simultaneously and wherein the step of propagating the first optical signal comprises the steps of:

providing the first optical signal in each of several optical paths within at least a timeslot/wavelength channel pairing; and,

performing within each path independently one of blocking the first optical signal and other than blocking the optical signal.

61. A method according to claim 59 wherein the step of performing one of blocking and other than blocking is performed in dependence upon availability data, the availability data indicative of a timeslot/wavelength channel pairing from the first node to the second node.

62. A method of allocating resources within an optical network comprising the steps of:

providing an optical wavelength switch having switching setup times of substantially less than one millisecond;

providing an optical source for generating optical signals within any of a plurality of different optical wavelength channels, the optical source capable of transmitting optical signals within two different wavelength channels spaced in time by substantially less than one millesecond;

determining a proposed timeslot/wavelength channel pairing from a first node and destined for a second other node, the proposed timeslot/wavelength channel pairing other than a known available timeslot/wavelength channel pairing;

setting up the optical wavelength switch for the determined proposed timeslot/wavelength channel pairing;

generating, using the optical source, a first optical signal within the determined timeslot/wavelength channel pairing at the first node and destined for the second other node;

providing the first optical signal to the optical wavelength switch; and,

when the timeslot/wavelength channel pairing is available propagating the first optical signal within the switching fabric to the second other node.

63. A method according to claim 62 wherein the step of propagating the first optical signal is performed absent a step of opto-electronic conversion and absent a step of wavelength conversion.

64. A method according to claim 62 wherein the step of propagating the first optical signal comprises the steps of:

providing the first optical signal in each of several optical paths within the timeslot/wavelength channel pairing; and,

performing within each path independently one of blocking the first optical signal and other than blocking the optical signal.

65. A method according to claim 62 wherein the first optical signal is generated by a light source dedicated to generating light within the known optical wavelength channel.

66. A method according to claim 65 wherein the light source is one of a plurality of light sources each dedicated to generating light within a different known optical wavelength channel.

67. A method according to claim 65 wherein the first optical signal is blocked within the switching fabric when the proposed timeslot/wavelength channel pairing to the destination node is unavailable.

68. A method according to claim 67 comprising the step of:

upon blocking of the first signal within the switching fabric, transmitting a message to the first node indicative of the first signal being blocked.

69. A method according to claim 68 comprising the step of:

generating a second optical signal within a second other timeslot/wavelength channel pairing at the first node and destined for the second other node and having the same data transmitted therein in response to the message; and,

providing the second optical signal to a switching fabric in response to the message.

70. A method according to claim 62 comprising the step of generating a second optical signal within a second other timeslot/wavelength channel pairing and including same data as the first optical signal; and,

providing the second optical signal to the switching fabric.

71. A method according to claim 70 wherein the light source includes a plurality of independent light sources each for generating light within a different wavelength channel.

72. A method of allocating resources within an optical network according to claim 71 wherein the first and second optical signals are provided to the switching fabric approximately simultaneously and wherein the step of propagating the first optical signal comprises the steps of:

providing the first optical signal in each of several optical paths within a same timeslot/wavelength channel pairing; and,

performing within each path independently one of blocking the first optical signal and other than blocking the optical signal.

73. A method of allocating resources within an optical network according to claim 70 wherein the step of performing one of blocking and other than blocking is performed in dependence upon availability data, the availability data indicative of a path and of a timeslot/wavelength channel pairing from the first node to the second node.

74. A method according to claim 62 comprising the steps of:

when an available timeslot/wavelength channel pairing is other than present, attenuating the first optical signal;

transmitting an indication that the first optical signal was attenuated;

generating another optical signal having same data and within a different timeslot/wavelength channel pairing for propagating within the switching fabric,

wherein from the step of generating the first optical signal to the end of the step of generating another optical signal requires less than one millisecond.

75. A method according to claim 62 comprising the steps of:

when an available timeslot/wavelength channel pairing is other than present, attenuating the first optical signal;

transmitting an indication that the first optical signal was attenuated;

generating another optical signal having same data within a different timeslot/wavelength channel pairing for propagating within the switching fabric,

wherein from the step of generating the first optical signal to the end of the step of generating another optical signal requires less than one millisecond more than the time it takes the optical signal to reach the second other node and return therefrom.

76. A method according to claim 74 including the step of:

configuring the switching fabric for propagating of the another optical signal within the timeslot/wavelength channel pairing prior to transmission thereof.

77. A method of allocating resources within an optical network comprising the steps of:

a) providing a same data signal modulated within each of a plurality of different optical signals within at least one timeslot/wavelength channel pairing within a same optical waveguide, the data signal for transmission from a source to a destination;

b) propagating at least one of the different optical signals from the source to the destination within a timeslot/wavelength channel pairing without buffering the data modulated therein; and,

c) attenuating at least another of the plurality of different optical signals to prevent propagating thereof from the source to the destination.

78. A method according to claim 77 wherein the step of propagating is performed absent converting the at least one of the different optical signals to another carrier wavelength

79. A method according to claim 77 wherein the step (a) providing a same data signal includes the step of transmitting the provided same data signals approximately simultaneously one to another.

80. A method according to claim 77 wherein the step (a) providing a same data signal includes the step of transmitting the provided same data signals in different timeslots, one after another.

81. A method according to claim 77 wherein the steps of (b) and (c) include the steps of:

when the timeslot/wavelength channel pairing within an optical path is available propagating the at least one of the different optical signals within the switching fabric to the destination absent a step of opto-electronic conversion and absent a step of wavelength conversion and receiving the at least one of the different optical signals at the destination; and,

when the timeslot/wavelength channel pairing within the optical path is unavailable attenuating the at least another of the plurality of different optical signals within the switching fabric to prevent interference therewith.

82. A method according to claim 77 wherein the step of propagating at least one of the different optical signals from the source to the destination comprises the steps of:

providing the at least one of the different optical signals in each of several optical communication paths within at least a timeslot/wavelength channel pairing; and,

performing within each path independently one of blocking the at least one of the different optical signals and other than blocking the at least one of the different optical signals.

83. A method according to claim 77 wherein the step of propagating at least one of the different optical signals from the source to the destination comprises the steps of:

providing the at least one of the different optical signals in each of several optical communication paths within at least a timeslot/wavelength channel pairing; and,

performing within each path in an interdependent fashion one of blocking the at least one of the different optical signals and other than blocking the at least one of the different optical signals.

84. A method according to claim 77 wherein the light source is one of a plurality of light sources each dedicated to generating light within a different known optical wavelength channel.